Research Article

A Comparison of Potentially Inappropriate Medications Identification Using Beers and STOPP Criteria in Hospitalized Geriatric Patients in Jakarta

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Abstract

Adverse Drug Events (ADE) are closely related to Potentially Inappropriate Medications (PIMs) among the elderly, and can cause an increase in morbidity, mortality, and medical cost. The tools often used to assess PIMs include Beers and Screening Tool of Older Persons' Prescriptions (STOPP) Criteria. Therefore, this study aimed to compare the PIMs identification using Beers 2019 and STOPP version 2 2016 Criteria. A descriptive-analytical method was used, and data were collected retrospectively from the medical records of 340 patients at Pondok Kopi Islamic Hospital period in 2018. The results showed that among 324 patients who met the inclusion criteria with Beers 2019, PIMs were present in 136 (41.85%), with 181 cases. Most of them were on criteria 3, namely 46 (25.41%) and 33 (18.23%) cases of furosemide and spironolactone, respectively. Meanwhile, out of 308 patients who met the inclusion criteria with STOPP, PIMs were found in 14 (4.55%) with a total of 18 cases. The use of aspirin or clopidogrel was observed in 7 people (38.89%) with uncontrolled severe hypertension, while NSAID usage was found in 3 uncontrolled severe hypertension patients (16.67%). Furthermore, there were 3 cases of aldosterone antagonist or ARB usage, which was combined with other drugs that can increase potassium without proper monitoring of the serum level (16.67%). In Pondok Kopi Islamic Hospital, Beers 2019 criteria can describe PIMs data better than the STOPP version 2 2016 due to data availability. Clinician and pharmacist collaboration is also needed in formulating the critical supporting data.

Keywords: Beers 2019, geriatrics, PIMs, STOPP version 2 2016 criteria

Perbandingan Identifikasi Obat yang Berpotensi Tidak Tepat Menggunakan Kriteria *Beers* dan Kriteria STOPP pada Pasien Geriatri Rawat Inap di Jakarta

Abstrak

Reaksi Obat yang Tidak Dikehendaki (ROTD) berkaitan erat dengan Obat yang Berpotensi Tidak Tepat (PIMs) pada lanjut usia dan selanjutnya menyebabkan peningkatan morbiditas, mortalitas, dan biaya pengobatan. Instrumen yang sering digunakan untuk menilai PIMs pada pasien lanjut usia adalah kriteria *Beers* dan STOPP. Penelitian ini bertujuan untuk membandingkan identifikasi PIMs menggunakan kriteria *Beers* 2019 dan kriteria STOPP versi 2 2016 pada pasien geriatri rawat inap di Rumah Sakit Islam (RSI) Pondok Kopi. Penelitian ini menggunakan metode deskriptif-analitis. Data dikumpulkan secara retrospektif berdasarkan rekam medis RSI Pondok Kopi periode tahun 2018. Populasi data adalah 340 pasien. Hasil penelitian menunjukkan bahwa dari 324 pasien yang memenuhi kriteria inklusi dengan kriteria *Beers* 2019, PIMs ditemukan pada 136 pasien (41,85%), dengan 181 kasus. Sebagian besar PIMs yang ditemukan berada pada kriteria 3, yaitu menggunakan furosemid sebanyak 46 kasus (25,41%) dan diikuti dengan penggunaan spironolakton sebanyak 33 kasus (18,23%). Sedangkan dari 308 pasien yang memenuhi kriteria inklusi dengan kriteria STOPP versi 2 2016, PIMs ditemukan pada 14 pasien (4,55%), sebanyak 18 kasus. PIMs yang paling banyak ditemukan adalah penggunaan aspirin atau clopidogrel dalam 7 kasus (38,89%) pada pasien dengan hipertensi berat yang tidak terkontrol diikuti oleh penggunaan NSAID pada pasien hipertensi berat yang tidak terkontrol pada 3 kasus (16,67%) dan antagonis aldosteron atau penggunaan ARB bila dikombinasikan dengan obat yang dapat meningkatkan kalium tanpa pemantauan kadar kalium serum pada 3 kasus (16,67%). Di RSI Pondok Kopi, kriteria *Beers* 2019 menggambarkan data PIMs lebih baik dibandingkan kriteria STOPP versi 2 2016 mempertimbangkan ketersediaan data. Kolaborasi klinisi dan apoteker diperlukan dalam merumuskan data pendukung yang diperlukan dalam menilai PIMs.

Kata kunci: *Beers* 2019, geriatri, PIMs, kriteria STOPP versi 2 2016

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Introduction

The population over 60 years is expected to be 2 billion by 2050 worldwide, increasing around 10% since 2015 (900 million).[1] While in Indonesia, the percentage of the elderly population in 2010 has reached 7.6% and is estimated to double to 15.77% in 2035.[2] Geriatrics tends to have comorbidities due to a decreased organ function (which leads to a gradual decrease in physical and mental capacity), psychological, social, economic, and environmental functions.[1,3] In Indonesia, the morbidity rate was 28.62% in elderly (in 2015).[4] The results of Riset Kesehatan Dasar in 2018, hypertension (63.5%), dental problems (53.6%), joint disorders (18%), oral problems (17%), diabetes mellitus (5.7%), heart disease (4.5%), stroke (4.4%), kidney failure (0.8%), and cancer (0.4%) were diseases suffered by the elderly.[2]

Research shows that polypharmacy is common in older adults.[5] Polypharmacy can be described as using multiple medications by a patient (generally five or more prescribed drugs/day). Polypharmacy can also be explained as administering more medications than are clinically indicated, which means patients receive unnecessary drug use.[6] There is a significant relationship between polypharmacy and negative clinical impacts.[5] The risk of Adverse Drug Reaction (ADR) exponentially increased when the number of drugs being used also increases. Polypharmacy leads to medication incompliance, low quality of life, and increased health costs.[6]

Reducing the risk of geriatrics experiencing medication errors implicates the utilization of an instrument that classified drugs based on the benefits and risks, some of them are the Beers and Screening Tool of Older Persons' Prescriptions (STOPP) criteria methods. Beers criteria are one of the most commonly used explicit criteria because its application is the easiest to follow, reproducible data were obtained, inexpensive, strong evidence, and most importantly, can identify potential medication inaccuracy.[7] Beers criteria have undergone several revisions. Beers criteria 2019 was the latest. This tool includes Potentially Inappropriate Medications (PIMs) in geriatrics apart from the clinical judgement, the medication use in elderly which cause drug—disease interactions or drug—syndrome interactions which may worsen the illness, PIMs in elderly considering the clinical condition, PIMs in the form of medications used carefully, potential drug-drug interaction that elderly should avoided, and the medication that their dosage should be reduced or should be avoided in elderly with various level of renal function.[8]

The STOPP criteria involve potentially inappropriate drugs as PIMs.[9,10] Version 2 2016 consists of 80 inappropriate medication use criteria describing clinical conditions (specific and commonly used medication) considered as PIMs in geriatrics. The STOPP criteria are arranged based on the physiological systems. Implementing the STOPP criteria to assess PIMs in Asia suggests that the STOPP criteria has a global relevance.[11]

Research in Cyprus with Beers 2015 criteria stated 16.9% PIMs during hospitalization at University Hospital.[12] Another similar research held at a hospital in Saudi Arabia found that the PIMs percentage was 57.6%.[13]

As many as 14.8% PIMs were found from a study which conducted in Turkey based on STOPP criteria.[14] Another study in Malaysia stated that PIMs prevalence was 34.9%. PIMs occurrence increases by 20% as the number of medications prescribed increases.[15] Research conducted in Indonesia showed that of 17% chronic kidney disease patients, the average of the PIMs was one, while as many as 38.9% of osteoarthritis patients experienced an average of one PIMs.[16,17] Another study in Indonesia stated that the PIMs prevalence according to STOPP criteria was 1.9%.[18]

The identification of PIMs with the STOPP and Beers criteria in Indonesia is still limited. We found it necessity to identify PIMs based on STOPP and Beers criteria to minimize the occurence of Adverse Drug Events (ADE). This research also compares the result of PIMs from STOPP and Beers criteria. The assessment is projected to guide health professionals in hospitals in treating geriatrics by sorting out what laboratory data or physical examination is essential to check so that PIMs can be appropriately assessed, either with Beers 2019 criteria or STOPP version 2 2016 criteria.

The study aims to determine the patient characteristics, assess PIMs in geriatric patients according to STOPP and Beers criteria, and compare PIMs using STOPP and Beers criteria at Pondok Kopi Islamic Hospital. The differences between this research and other similar research conducted in Jakarta were the comparison of PIMs using STOPP and Beers, and the higher number of samples.

Methods

This retrospective study was descriptive using Beers 2019 criteria and STOPP version 2 2016. The population is geriatric patients hospitalized at Pondok Kopi Islamic Hospital 2018 period. The patients used for evaluation with Beers and STOPP criteria were from the same subset. Purposive sampling method was used. All geriatric inpatients at Pondok Kopi Islamic Hospital 2018 period that met the inclusion criteria as follows were the samples of this study.

The inclusion criteria were respondents aged 60 years or older, had sufficient data from medical record (sex, age, diagnosis, comorbidities, medication use, and laboratory data). Exclusion criteria were geriatric hospitalized patients at Pondok Kopi Islamic Hospital 2018 period which had no adequate laboratory data.

The research permit was obtained before the data were taken. The study proposal was submitted to the Faculty of Pharmacy and Science's Ethics Committee, Universitas Muhammadiyah Prof. Dr. HAMKA. The research obtained the Ethical Approval test with protocol number 03/19.09/0178. The data obtained (from medical records) was then recapitulated for data analysis to get a frequency distribution and the proportion of the research's variable (i.e. the characteristic of the patient). STOPP and Beers criteria will determine the percentage of the samples which have PIMs and what drugs with the most PIMs. Thereafter, the PIMs using STOPP and Beers criteria were compared.

Results

Data from 340 patients were obtained, but only 324 respondents met the inclusion criteria as samples for Beers 2019 criteria. Only 308 respondents met the inclusion criteria as respondents for the STOPP version 2 2016 criteria. Patients with no laboratory data needed for PIMs identification were excluded.

Patient characteristic
Table 1 shows the distribution of patients based on patient characteristics. The majority of respondents were female (54.12%). Most respondents were aged 60–74 years (81.17%). Most respondents were hospitalized for 2–5 days (78.24%), with the most common diagnosis being gastrointestinal disorder (28.23%), and most respondents had one disease (57.94%). The majority of respondents used 6–10 medicines (60.60%).

PIMs according to Beers 2019 and STOPP version 2 2016 criteria
Based on Table 2, PIMs are more commonly found using Beers criteria due to the availability of supporting data, i.e., laboratory data.

107

Table 1 Patients' Characteristic

Characteristic		Frequency	%
Sex	Male	156	45.88
	Female	184	54.12
Age	Elderly (60–74 years)	276	81.17
	Old (75–90 years)	64	18.83
Length of stay/LOS (days)	2–5	266	78.24
	6–10	67	19.71
	11–15	7	2.05
Diagnose (system)	Gastrointestinal	107	28.23
	Cardiovascular	100	26.39
	Endocrine	74	19.53
	Infection	37	9.76
	Respiratory	33	8.71
	Renal	28	7.38
The number of diseases	1	197	57.94
	2	86	25.3
	3	51	15.00
	≥4	6	1.76
The number of medicines	1–5	90	26.49
	6–10	206	60.6
	11–15	40	11.78
	16–20	4	1.14
Total		**340**	**100.00**

PIMs according to Beers 2019 criteria

In accordance with Beers 2019 criteria, in category 1 (potentially inappropriate drugs for older people), benzodiazepines (alprazolam) were the most used with a percentage of 13.26%, as seen in Table 3. Category 2 (potentially inappropriate drugs because of drug-diseases interactions that can worsen the disease) is the PIMs event with the most negligible prevalence. Category 3 (drugs used with particular concern) has the highest number of PIMs events (moderate quality of evidence and strong recommendation).

In category 5 (drugs should be avoided or reduced in dosage by assessing the level of renal function in geriatrics), most PIMs were the use of ranitidine (16.02%).

PIMs according to STOPP version 2 2016 criteria

In accordance with the STOPP version 2 2016 criteria, the most common PIMs were aspirin or clopidogrel use in patients with severe uncontrolled hypertension (38.89%). Other common PIMs were the use of NSAIDs in a patient with severe uncontrolled hypertension

Table 2 PIMs According to Beers 2019 Criteria and STOPP Version 2 2016 Criteria at Pondok Kopi Islamic Hospital

Beers 2019 Criteria	STOPP Version 2 2016 criteria
PIMs were present in 136 patients (41.85%), with a total of 181 cases. Most PIMs found were on criteria 3, i.e., the use of furosemide as much as 46 cases (25.41%) and followed by spironolactone for 33 cases (18.23%).	PIMs were present in 4.55% of patients (14), with a total of 18 cases. Most PIMs was the use of aspirin or clopidogrel in 7 cases (38.89%) in patients with uncontrolled severe hypertension followed by NSAID use in uncontrolled severe hypertension patients in 3 cases (16.67%) and aldosterone antagonist or ARB use when combined with drugs that can increase potassium without monitoring potassium serum level in 3 cases (16.67%).

Table 3 List of PIMs according to Beers 2019 Criteria

PIMs Category	Drug Name	Quality of Evidence	Strength of Recommendation	n	%
Category 1	Chlorpheniramine	Moderate	Strong	2	1.10
	Dimenhydrinate	Moderate	Strong	3	1.65
	Chlordiazepoxide-Clidinium	Moderate	Strong	7	3.87
	Nifedipine	High	Strong	4	2.21
	Alprazolam	Moderate	Strong	24	13.26
	Diazepam	Moderate	Strong	4	2.21
	Estazolam	Moderate	Strong	1	0.55
	Glimepiride	High	Strong	12	6.63
Category 2	Estazolam	Moderate	Strong	1	0.55
	Mefenamic acid	Moderate	Strong	2	1.10
Category 3	Haloperidol	Moderate	Strong	1	0.55
	Furosemide	Moderate	Strong	46	25.41
	Hydrochlorothiazide	Moderate	Strong	2	1.10
	Spironolactone	Moderate	Strong	33	18.23
	Tramadol	Moderate	Strong	4	2.21
Category 5	Ciprofloxacin	Moderate	Strong	1	0.55
	Spironolactone	Moderate	Strong	3	1.65
	Gabapentin	Moderate	Strong	1	0.55
	Tramadol	Low	Weak	1	0.55
	Ranitidine	Moderate	Strong	29	16.02
	Total			**181**	**100.00**

(16.67%) and the use of aldosterone antagonists (spironolactone, eplerenone), ARB when combined with drugs that can increase potassium (ACEI, amiloride) without monitoring potassium serum level (16.67%).

Discussion

Patient characteristics data showed that most respondents were female (54.12%). This result is in line with the data in 2017

Table 4 List of PIMs According to STOPP Version 2 2016 Criteria

System	PIMs criteria	n	%
Gastrointestinal	An anti-motility drug (loperamide) for the patient with bloody or slimy stool	1	5.56
Cardiovascular	1. Aldosterone antagonists (spironolactone, eplerenone), ARB when combined with drugs that can increase potassium (ACEI, amiloride) without monitoring potassium serum level	3	16.67
	2. Loop diuretics as a treatment for hypertension	1	5.56
	3. ARB with hyperkalemia	1	5.56
Anticoagulant and antiplatelet	1. Aspirin or clopidogrel with severe uncontrolled hypertension (systolic BP ≥185 mmHg or diastolic BP ≥110 mmHg)[45]	7	38.89
	2. Aspirin co-prescribed with clopidogrel as a secondary stroke prevention	2	11.11
Musculoskeletal	NSAID with severe uncontrolled hypertension (systolic BP ≥185 mmHg or diastolic BP ≥110 mmHg)[45]	3	16.67
	Total	**18**	**100.00**

on Indonesia's geriatrics population, which indicated that the proportion of older women is higher (9.53%) than older men (8.54%).[4] Most patients were aged 60 to 74 years (81.17%). Based on data of the population pyramid in Indonesia, from 1971 until 2035, the population aged 60–64 is considerably higher than other elderly groups. Elderly aged >75 years has the smallest proportion but is predicted to increase 2-fold from 2020 to 2035.[19]

The majority of respondents used 6–10 medicines (60.60%). Polypharmacy is a significant risk factor for ADR. A cohort study at a hospital in Pakistan and a research at Malaysian hospital stated that the elderly are more prone to ADR due to comorbidity and polypharmacy.[20,21] The percentage of polypharmacy was 62.8% among geriatric inpatients and was related to the high prevalence of diabetes mellitus and cardiovascular diseases.[21] A review involving 7 research in the study indicated some consequences related to polypharmacy, such as low medication adherence, unwanted side effects, and a high risk of a geriatric syndrome.[22] Another review involved 16 study, proved that the potential number of ADR is 6% approximately among geriatric patients when using two drugs, then rises when five medications are taken to 50%, then reaches 100% when eight or more drugs are taken concomitantly.[23] A previous study in 2 hospitals in Jakarta, Indonesia, found that polypharmacy is an independent risk factor for PIMs incidence.[24] From those previous research, it may be declared there is a correlation between number of medications used and PIMs.[20–24]

As seen in Table 1, cardiovascular and endocrine disorders rank second and third in samples, which can be seen as a factor leading to polypharmacy on this research. This result is similar to two previous studies, namely studies in Malaysia and Finland, which showed that the occurence of polypharmacy among

geriatrics was related to the high prevalence of cardiovascular diseases and diabetes mellitus.[21,25] The predominant factors that cause cardiovascular disease to cause polypharmacy compared to other diseases are elderly, abnormal weight (underweight or obese), a family history of cardiovascular disease, and comorbidity.[26] This is strengthened by another study that stated that cardiovascular disease is increasing in the elderly with multiple comorbidities. The guideline recommends multiple drug use to control the disease, leads to an increased number of adverse effects.[27]

Polypharmacy also becomes a concern in a patient with diabetes mellitus. The main factors which complicate the diabetes managements are old age, comorbidities, and diabetes complications (macrovascular and microvascular).[28] Patients with diabetes mellitus significantly had more comorbidities and received more drugs than non-diabetes mellitus patients. Polypharmacy is considered the main concern in geriatric diabetes mellitus patients.[29]

Beers criteria provide a higher chance for patients to be evaluated than STOPP criteria. The STOPP criteria require more specific supporting data to assess PIMs in geriatric patients. In this study, 32 data with STOPP criteria could not be evaluated because they did not have Partial Pressure of Oxygen (PO_2), Partial Pressure of Carbon Dioxide (PCO_2), and potassium serum data. In Beers criteria, only 16 data were found incomplete (creatinine serum) to be evaluated. Similar research also found out that PIMs are found more by the Beers criteria compared to STOPP criteria, with the prevalence of PIMs were varied from 26.31% to 71.9% with Beers, compared to STOPP with the prevalence of PIMs were varied from 14.03% to 67.3%.[30–33]

Based on Beers 2019 criteria, in category 1, these results in this study are in line with the previous study, which stated that most drugs included in PIM category 1 are

benzodiazepines.[34] The use of benzodiazepine in geriatrics should be avoided because the sensitivity to benzodiazepines has increased, and the metabolism of long-acting drugs has decreased in older people.[35] Reduction in first-pass metabolism of many drugs, including long-acting agents, through the cytochrome P-450 enzyme system, is typical in older people due to liver mass and blood flow reduction.[36,37] All benzodiazepine drugs increase the risk of cognitive impairment, delirium, fractures, falls, and accidents with a motor vehicle in the elderly.[38]

In category 2, NSAIDs use in geriatrics with chronic kidney disease with creatinine clearance levels <30 mL/min should be avoided because it can elevate the risk of acute kidney injury (AKI) and decrease kidney function. NSAID drugs inhibit prostaglandin synthesis, which results in vasoconstriction in the renal medulla, which can worsen kidney failure.[39]

Previous studies showed that most PIMs in category 3 were diuretic drugs.[40] These results are in line with studies conducted in Pondok Kopi Hospital, where the use of furosemide is the most PIMs (25.41%), followed by the use of spironolactone (18.23%). There should be careful use of diuretics in the elderly because it can cause Syndrome of Inappropriate Antidiuretic Hormone (SIADH). ADH excess will cause increased water reabsorption from the kidney tubules, resulting in water retention and hyponatremia. Risk factors for hyponatremia are old age, women, diuretic users, and low sodium concentrations. It requires close monitoring of sodium levels when starting and changing doses because it can increase the risk in geriatric patients.[41]

According to Beers 2019 criteria, in category 5, the use of ranitidine should be reduced in patients with creatinine clearance <50 mL/min because it can cause changes in mental status. Side effects of this drug include headaches, skin rashes, bradycardia, and hypersensitivity.

Ranitidine may cause adverse reactions to the central nervous system at the usual doses, especially in elderly patients who have substantial impairment of kidney function.[42]

The use of aspirin or clopidogrel in a patient with severe uncontrolled hypertension poses a high risk of bleeding. Optimal antiplatelet therapy in geriatric patients is still unclear due to efficacy and safety issues. Multiple organ dysfunction and comorbidities in geriatrics may, on one side, reduce the drug's therapeutic effects. On the other side, they lead to increased susceptibility to side effects and drug toxicity (the bleeding risk),[43,44] as seen in Table 4. However, other guidelines mention only thrombolytic drugs such as alteplase, which put this as a contraindication criterion, whereas antiplatelet drugs such as aspirin and clopidogrel do not.[45]

The use of NSAIDs in a patient with severe uncontrolled hypertension will increase the risk of exacerbation of hypertension. Inhibition of the cyclooxygenase-2 enzyme is associated with reduced production of prostaglandin E2, there will be a decrease in daily sodium extraction through urine, causing edema and hypertension.[46] Non-selective NSAIDs may attenuate the antihypertensive effect of some blood pressure medications. NSAIDs can increase blood pressure by two to five mmHg.[47]

The use of aldosterone antagonists (spironolactone, eplerenone), ARB, when combined with drugs that can increase potassium (ACEI, amiloride) without monitoring potassium serum level, poses a risk of hyperkalemia for the elderly. Research in Turkey indicated that serum potassium levels positively correlate with hospital length of stay, hospital expenses, mortality rates, and the number of comorbid diseases.[48]

There is some limitation to this study. Since the study design was retrospective, the author did not assess the impact of PIMs or the incidence of ADRs in the samples and did

not recommend the Potentially Prescribing Omission (PPO). This study cannot be generalized as the study reviewed only 340 patients' medical records in one hospital in Jakarta. It is recommended to conduct similar research with prospective study design in some hospitals representing the Jakarta area.

Conclusions

The number of PIMs in this research was moderate (41.85%) with Beers 2019 criteria and considered low (4.55%) with STOPP version 2 2016 criteria. Most PIMs found with Beers criteria were the use of furosemide (25.41%). In contrast, most PIMs found with the STOPP version 2 criteria were the use of aspirin or clopidogrel (38.89%) in patients with severe uncontrolled hypertension. In Pondok Kopi Islamic Hospital, Beers 2019 criteria describe PIMs data better than the STOPP version 2 2016 criteria considering data availability. Supporting data is crucial when PIMs are being assessed. Clinician and pharmacist collaboration is needed in formulating the critical supporting data so that PIMs can be appropriately evaluated.

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Conflict of Interest

All authors declared no potential conflicts of interest to this article's research, authorship, and or publication.

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